Table of Contents Part 3

Getting Started

After you have been trained on the use and care of the water monitoring equipment, either at an in-person training or in the field with a hands-on trained SEC leader, you're ready to monitor water-quality at the stream(s) that has been selected for you to observe. Before doing so, please review the Safety Checklist as well as the Equipment Checklists. This will make sure you have everything you need and also help to keep you safe.

Water Quality Monitoring Equipment Checklist

(not including equipment for benthic macroinvertebrate survey)

- □ Colorimeter
- □ Oakton Multi-parameter Meter
- □ Older Hach "Visual" Test Kit (optional if no access to Colorimeter)
- □ Standard Solutions
- □ Disposable vinyl gloves (non-latex)
- □ Waterproof boots/shoes
- □ Windbreaker (and pants if available)
- □ Orange safety vests
- □ Towel (for drying equipment/ to sit on)
- □ Change of clothes and shoes
- □ Clipboard
- □ Field manual data sheets (See Appendix)
- □ Painter's masks
- □ Pencils/waterproof pens
- □ Notebook paper
- □ Small towels (hand drying, etc.)
- □ Plastic trash bags
- □ Camera with film
- □ Stopwatch
- □ 25 meter rope or tape measure
- □ Plastic spoon
- □ Small glass jar
- □ Flow-measuring bobber/20 meter nylon line
- □ Wastewater disposal container (hazardous)
  - □ Nitrate Test (cadmium)
  - □ Sulfate Test (barium)
- □ Wastewater disposal container (nonhazardous)
- □ First aid kit
- □ Eyewash bottle
- □ Matches
- □ Waterless hand wash or hand wipes
- □ Meter stick (for depth measurements)
- □ Duffle bag
- □ Camp table
- □ Calculator
- □ Extension water sampler/bottle
- □ Scissors
- □ Matches

Please send suggestions and comments to:

Nature Abounds
c/o PaSEC Coordinator
PO Box 241
Clearfield, PA 16830
volunteer@natureabounds.org

Colorimeter (DR850) Inventory

With the Colorimeter, you can measure for 50+ different parameters. For the list below, only what you need for the mandated PaSEC measured parameters is listed.

Part #	Description	Quantity
4845000	DR850 Colorimeter (includes 2 sample cells, COD/Test-N-Tube adapter, Instrument, Procedure Manual, and Batteries)	1
4942500	Instrument Carrying Case Hard Sided, DR/800 colorimeter	1
2087079	Bottle w/cap 500 ML	1
50071H	Beaker, Low Form 50ml	1
2105769	**IRON** - Ferrover Iron Reagent, 10 mL, 100 / pk	1
2515025	**D.O.** - Dissolved Oxygen Reagent pk/25 Ampules, High Range	2
2106069	**Phosphate** - Phosver 3 pwd plws 10mL pk/100	1
2106769	**Sulfate** - Sulfaver 4 sulfate reagent pk/100	1
2106169	**Nitrate** - Nitraver 5 Nitrate reagent 10 mL sample pk/100	1
2676100	**Thermometer,** Pocket non-mercury (double Temp check)	1
2444301	**ALKALINITY TEST KIT**	1
438-00	Tube, Measuring Plastic 5.83ml	1
942-99	Phenolphthalein Pwd Plws (pkg 100)	1
943-99	Bromcresol Gr-Meth Red Pwd Plws (pkg 100)	1
2327-06	Bottle, MXG Marked	1
26205-32	Sulfuric Acid, 0.035N 100ml MDB	1
	Instructions, AL-AP MG/L Instructions, Safety & Disposal Blue Carrying Case, HC-1 Material Safety Data Sheets	1
	STANDARD SOLUTIONS	
13949	Iron Std, 1mg/L 500mL AS Fe (Nist)	1
30749	Nitrogen-Nitrate Std 10mg/L as NO3-N, 44.3 mg/L as NO3, 500mL	1
256949	Phosphate Std, 1mg/L 500mL	1
257849	Sulfate Std, 50mg/L 500ml	1
2974649	TDS Std , 500ml	1
2769920	Singlet Combo pH 4.01& 7.0, 10 Each	1
	Orange “Homer” Carrying Kit (new)	1

TOTAL-PHOSPHATE TEST (when needed, use from old kit)

New Oakton Multi-Parameter PCSTestr35

2519800	pH/Total Dissolved Solids/Salinity/Conductivity/Temp. Meter	1
	Instructions	
Test	**Range**	
pH	0.00 to 14.00	
Conductivity	0.0 to 199.9 µS/cm/ 1.0 200 to 1999 µS/cm/ 2.0 2.00 to 20.00mS/cm	
Total Dissolved Solids	0.0 to 99.9ppm 1.0 100 to 999 ppm 2.0 1.00 to 10.00 ppt	
Salinity	0.0 to 99.9ppm 1.0 100 to 999 ppm 1.00 to 10.00 ppt 0.0 to 1.00%	
Temperature	0 to 50.0 ˚C 32 to 122.0 ˚F	

Hach "Visual" Test Kit (Older) Inventory

GENERAL EQUIPMENT DESCRIPTION	QUANTITY
Goggles, Safety Clear	4
Thermometer, Pocket	1
Screwdriver, Jeweler's	1
Demineralizer Bottle	1
Rinse Bottle	1

Part #	Description	Quantity
14161-33	**NITRATE TEST KIT**	1
1732-00	Color Comparator Box, Hach Logo	1
14078-99	NitriVer 3 Pwd Plws 5ml (pkg 100)	1
14120-99	NitraVer 6 Pwd Plws 5 ml (pkg 100)	1
14161-88	Instructions, NI-14 Test Kit	1
14171-00	Color Disc, Nitrate Low Range	1
14197-00	Dropper, Glass	1
46600-00	Plastic Color Viewing Tube	2
46600-88	Instructions, Color Viewing Tube	1
46600-10	Color Viewing Tube, cap	1
46601-00	Blue Carrying Case, HC-1	1
26853-00	Instructions, Safety & Disposal	1
	Material Safety Data Sheets	1

Part #	Description	Quantity
24443-33	**ALKALINITY TEST KIT**	1
438-00	Tube, Measuring Plastic 5.83ml	1
942-99	Phenolphthalein Pwd Plws (pkg 100)	1
943-99	Bromcresol Gr-Meth Red Pwd Plws (pkg 100)	1
2327-06	Bottle, MXG Marked	1
23497-32	Sulfuric Acid, 0.035N 100ml MDB	1
24443-89	Instructions, AL-AP MG/L	1
26853-00	Instructions, Safety & Disposal	1
44401-00	Blue Carrying Case, HC-1	1
	Material Safety Data Sheets	1

Hach "Visual" Test Kit (Older) Inventory *(Continued)*

Part #	**Description**	Quantity
1469-34	**DISSOLVED OXYGEN TEST KIT**	1
438-00	Tube, Measuring Plastic 5.83ml	1
439-06	Bottle, Sq Glass 29ml	1
968-00	Clippers for medium powder pillows	1
981-99	Dissolved Oxygen 1 Pwd Plws (pkg 100)	1
982-99	Dissolved Oxygen 2 Pwd Plws (pkg 100)	1
987-99	Dissolved Oxygen 3 Pwd Plws (pkg 100)	1
1469-88	Instructions, OX-2P Test Kit	1
1909-02	Bottle, BOD 60ml w/30ml Line	1
5994-35	Plastic Molded Insert	1
24089-32	Sodium Thiosulfate Std, 0.0109N	1
26853-00	Instructions, Safety & Disposal Ea	1
	Blue Carrying Case, HC-3	1
	Material Safety Data Sheets	1

Part #	**Description**	Quantity
2250-01	**TOTAL PHOSPHATE TEST KIT, PO-24**	1
272-42	Water, Deionized (Demineralized)	2
439-00	Bottle, Sq Glass 29ml	1
505-01	Flask, Erlenmeyer 50ml	1
634-00	Clamp, Test Tube	1
1046-33	Filtration Aid Soln 29ml DB	1
1083-67	Funnel, Analytical pp 65mm	1
1730-00	Glass Tube, Color Viewing 5ml Mark	2
1731-00	Stopper, Blue	2
1732-00	Color Comparator Box, Hach Logo	1
1894-57	Filter Paper, Fold 12.5cm (pkg 100)	1
2125-49	Phosver 3 Phosphate Rgt Pwd Plws (pkg 50)	1
2250-35	Plastic Molded Insert	1
2250-38	Instructions, PO-24 Test Kit	1
2327-00	Bottle, MXG Marked	1
2414-00	Cylinder, holder for dropper	1
2449-32	Sulfuric Acid 5.25N 100ml MDB	1
2450-32	Sodium Hydroxide 5.0N 100ml MDB	1
2451-99	Potassium Persulfate Pwd Plws (pkg 100)	1
14197-00	Dropper, Glass	1
24122-01	Long Path Viewing Adaptor	1
46605-00	Blue Carrying Case	1
	Material Safety Data Sheets	

Hach "Visual" Test Kit (Older) Inventory *(Continued)*

Part #	**Description**	Quantity
2251-0	**SULFATE TEST KIT**	1
12065-66	SulfaVer 4 Pwd Plws (pkg 50)	1
46814-00	Dipstick, Sulfate Measure	1
24102-01	Sample Cell	1
24102-02	Sample Cell Cover	1
2172-40	Cylinder, Graduated, Polymethylpentene	1
	Instructions, SF-1 Test Kit	1
	Material Safety Data Sheets	1

Criteria for selecting a monitoring site:

There are many different reasons for selecting certain stream sites, such as proximity to volunteer homes, accessibility, or location in potential problem areas. Teachers and students may monitor streams for educational purposes or local community groups may want to determine whether a particular land use activity is, in fact, having an impact on stream health. There are a few guidelines you should follow in selecting sites:

1. The land must be easily accessible. There should be a safe place to park your car. The path to the stream should not be too long or over very rough terrain. If the land is privately owned, written permission from the landowner must be obtained (see the sample permission form).

2. The area around the stream site should be free of obvious hazards. Avoid areas with steep banks, heavily undercut banks, obvious heavy pollution, or other potential hazards.

3. Do not monitor at sites near fragile ecosystems (*e.g.,* wetlands) that you would have to tramp through to get to the stream. You may end up doing more harm to the ecosystem than good to the stream.

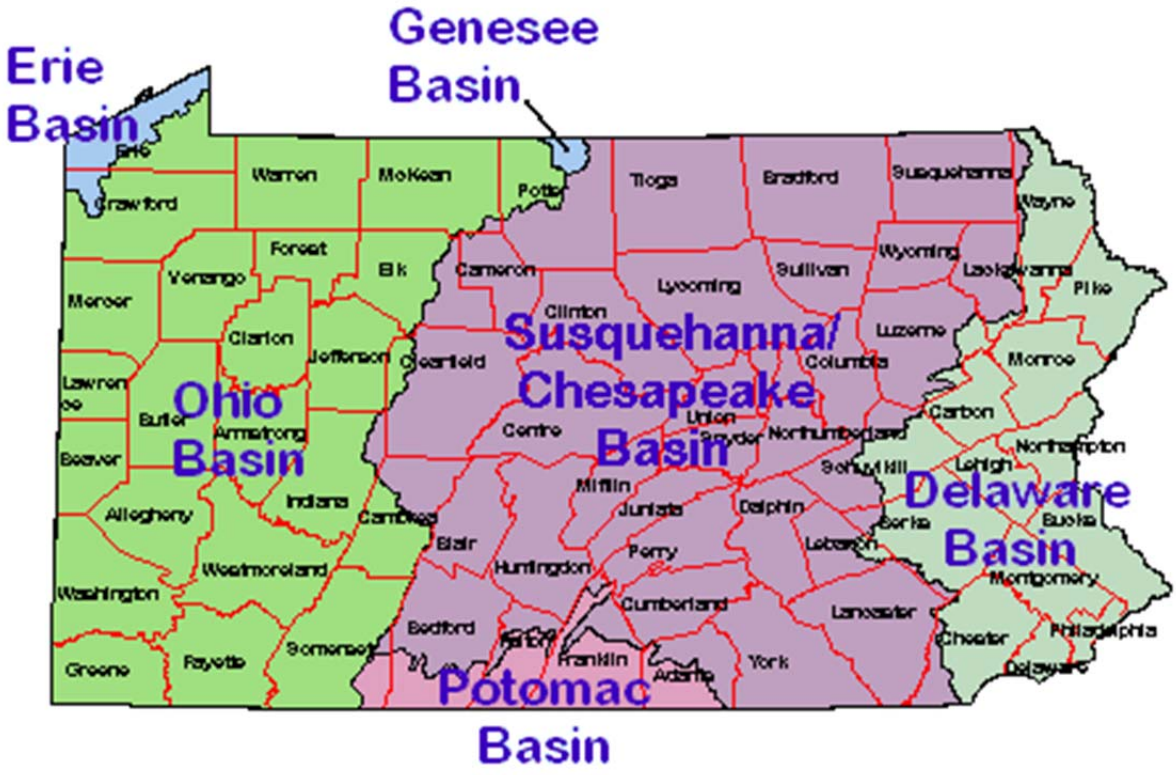
4. For providing baseline data to characterize a stream or screen for problems, you might want to monitor a number of sites representing a range of conditions in the stream's watershed. For example, you might choose a site above the problem area where the stream is "unimpaired," a site at the problem area, and a site below the problem area.

5. Check to see if the area is already being monitored. There are many volunteer organizations and school groups throughout the state performing monitoring. You may be able to partner with existing organizations.

6. Develop a "Study Design" or watershed management plan for the waterbody where the potential monitoring site is located. Use resources provided to you, or you can also find information on the internet by using search terms like "watershed study design".

For those sites that are chosen, the key to successful monitoring will be consistent, regular monitoring over time.

Pennsylvania Watersheds



What watershed basin do you live in? For more Pennsylvania watersheds information, maps and projects, as well as Pennsylvania's State Water Plan, go to PA DEP's website at:
http://www.pawaterplan.dep.state.pa.us/statewaterplan/docroot/default.aspx

Hydrologic Unit Codes

A Hydrologic Unit Code (HUC) System, developed by the Water Resources Council, is a hierarchial classification of hydrologic drainage basins in the United States. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to eight digits based on the four levels of classification in the hydrologic unit system

You can find your HUC by entering your zip code at the following EPA website: http://water.epa.gov/type/watersheds/index.cfm .

More information about HUCs can also be found at the following Unites States Geological Survey (USGS) website: http://water.usgs.gov/nawqa/sparrow/wrr97/geograp/geograp.html .

Weather and Wildlife Observing

Why Observe Weather and Wildlife?

Due to the increased emissions of greenhouse gases, among other factors, our climate is changing. Accurately recording and analyzing "ice on" and "ice off" events (also known as ice phenology) as well as other factors like air temperature, precipitation, weather events, and wildlife observations offers a practical way to learn how climate change affects our environment.

Around the globe, scientists have studied the freezing and thawing of ice on freshwater lakes, concluding that the climate is indeed warming. Likewise, scientists around the globe have been studying weather as well as wildlife behavior.

Seasonal differences in the ice cover of lakes and rivers can have a serious impact on our ecosystems. For example, changes in the migration patterns and breeding seasons of birds, food supplies for fish and mammals, water temperature and water chemistry, can occur. By recording your wildlife and weather observations while monitoring your stream, it gives scientists a more comprehensive of that eco-system.

In between observing and monitoring your stream site, if you'd like to (note this is optional) monitor weather and wildlife in your backyard or at a local park, you can do so through Nature Abounds other citizen-science opportunities IceWatch USA and Watch the Wild. Forms and Resources can be found in the "Extras" Appendix. Instructions for "Getting Started" can be found on the Nature Abounds website at www.natureabounds.org under Initiatives. You can also contact Melinda at Nature Abounds with any questions. She can be reached at either (814)765-1453 or volunteer@natureabounds.org .

Safety

Remember wildlife observing should be completed from a distance, and only if your site is accessible. Again, your safety is our number one concern.

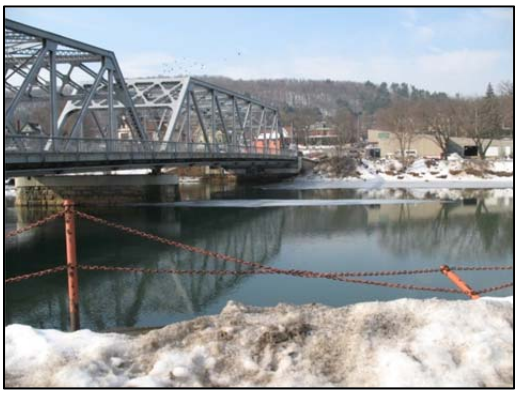
Likewise, for winter weather observations, do not walk onto a freezing body of water or to the direct edge of a shoreline. Observations should be done from a spot where your feet are firmly on the ground.

Ice Coverage Examples:

Ice-on: Ice *completely covers* the water body.

Ice-off: Ice goes out or *completely disappears* from the water body.

Partial Ice Coverage: Water body has some ice coverage but also open water sections.



Chapter 3:

Safety and Health

Safety and Health Checklist

We are pleased that you have decided to be a member of the Pennsylvania Senior Environment Corps and a volunteer water quality monitor. **Your safety and health are of number-one importance,** particularly when you are working outside. There are several important things to remember when you are monitoring at a stream or other body of water. If you follow these "rules of the river," you will have a fun, enjoyable and accident-free experience!

BEFORE VISITING YOUR SITE:

- □ Always monitor with at least one partner. Teams of three or four are preferred.
- □ Always let someone else know where you are, when you intend to return, and what to do if you don't come back at the appointed time.
- □ If you own one, take your cellular phone with you in case there is an emergency.
- □ Carry the phone number and location of the nearest medical center to your monitoring site and the location of an accessible phone nearby should you need to call for help.
- □ Carry the phone number of your program coordinator and others you may need to contact.
- □ Listen to weather reports. DO NOT go sampling if severe weather is predicted (lightning, flooding, ice, etc.); stop monitoring if a storm occurs while you are at the site.
- □ Carry a list of any important medical conditions of team members (*e.g.,* heart conditions or allergic reactions to bee stings) and emergency responses needed.
- □ Carry a First Aid Kit and be sure to check the contents before leaving to monitor.
- □ Some of the chemicals in the test kits are poisonous if ingested. Carry the number of the local poison control center.
- □ Carry a booklet or laminated card with emergency phone numbers.

RULES TO MONITOR BY:

- □ Never wade in swift or high water.
- □ DO NOT monitor if the stream is at flood stage.
- □ If you drive, park in a safe location. Be sure your car doesn't pose a hazard to other drivers and that you don't block traffic.
- □ Put your wallet and keys in a safe place. If wading in the stream place them in a watertight bag you keep strapped to your waist or they might end up downstream.
- □ Never cross private property without the permission of the landowner.
- □ Confirm that you are at the proper site location by checking maps, site descriptions, or directions.

If you observe any of the following at your sampling station - STOP! - do not monitor.
Call your PA DEP Regional Office (phone numbers in section titled Emergency Protocol) or 1-800-541-2050.

STOP! If you observe closed or leaking drums in the stream or on the stream bank.
STOP! If you observe an oil sheen on the water.
STOP! If you observe a large quantity of dead fish or other organisms.
STOP! If you observe a pipe discharging some odd looking/smelling substance into the stream.
STOP! If you observe any kind of illegal dumping into waterways.

Do not monitor if stream site is posted as unsafe for body contact.

- □ During monitoring, keep your hands away from eye and mouth areas.
- □ Always wash your hands thoroughly with soap and water after monitoring.
- □ Never eat after monitoring without first washing your hands.
- □ When monitoring at a potentially polluted site or near a wastewater treatment plant, a painter's mask should be worn to protect against aerosols (windborne contaminants).
- □ Watch for poison ivy, poison oak, sumac, and other types of vegetation that can cause rashes and irritation.
- □ Watch for irate dogs, wildlife (particularly snakes), ticks, and insects that may sting.
- □ Know what to do if you or your team members get bitten or stung.
- □ Never drink the water from the stream.
- □ Do not walk on unstable stream banks that may collapse.

Be very careful when walking in the stream. Rocky-bottom streams can be very slippery and can contain deep pools; muddy-bottom streams might also prove treacherous in areas where mud, silt, or sand has accumulated in sinkholes.

If you must cross the stream:

- □ Use a walking stick to steady yourself and probe for deep water or muck.
- □ A partner should wait on dry land ready to assist in case of an accident. If you and/or your partner are carrying a cellular phone, also leave it with the partner on dry land in case of an accident.
- □ Do not cross streams that are swift and above the knee in depth.
- □ Wear waders and rubber gloves in streams suspected of having significant pollution problems.

Safety and Health Checklist *(Continued)*

If sampling from a bridge:

□ Be wary of passing traffic.

□ Never lean over bridge rails unless you are firmly anchored to the ground or the bridge with good hand and foot holds.

STOP! If at any time you feel uncomfortable about the condition of the stream or your surroundings, stop monitoring and leave the site at once. Your safety is more important than the data!!

CHEMICAL KIT SAFETY

□ It is very important when working with chemicals to know the proper handling techniques and possible hazards. Even though the chemicals in the kits are used in very small amounts and are for the most part considered non-hazardous they still can be potentially harmful to you and/or the environment. Following the guidelines below will ensure your safety and well being.

□ Know your equipment, sampling instructions, and procedures before going out into the field. Enclosed in each test kit and in this manual is a Material Safety Data Sheet (MSDS) for each of the chemicals. These sheets are provided by the chemical company and contain very specific information on the chemical and the proper first aid if someone ingests the chemical, or if it comes in contact with someone's eyes or skin.

□ Read the MSDS sheet for each chemical that you will be handling to familiarize yourself with the potential hazards. Know where your MSDS sheets are located when monitoring in the field.

□ Keep all equipment and chemicals away from small children.

□ Avoid contact between chemical reagents and skin, eyes, nose, and mouth.

□ Wash hands directly after doing the chemical tests and before eating.

□ Never use your fingers to stopper a sample bottle (*e.g.*, when you are shaking a solution).

□ Wear goggles when handling chemicals.

□ Know chemical cleanup and disposal procedures. Wipe up all spills when they occur.

□ Close all containers tightly after use. Do not switch caps.

□ Do not expose chemicals or equipment to temperature extremes or long-term direct sunshine.

Emergency Protocol

From time to time water quality monitors may come upon situations that may require immediate action. **STOP! If you observe any of the following at your sampling station:**

1. Closed or leaking drums in the stream or on the stream bank.
2. An oil sheen on the water.
3. A large quantity of dead fish.
4. A pipe discharging some odd looking/smelling substance into the stream.
5. If you observe any kind of illegal dumping into waterways.

STOP! Do not sample or allow water to come in contact with your skin!

STOP and call your Pennsylvania DEP Regional Office or the DEP Main Emergency Number at 1-800-541-2050. You should have your camera with you for use in photo documenting your observations. Below you will find the listing of DEP's regions, counties served and call-in numbers for you to use if necessary.

Region	Emergency Phone	Region Headquarters	Counties Supervised
Northeast	**570-826-2511**	2 Public Square Wilkes-Barre, PA 18711 Phone: 570-826-2511	Carbon, Lackawanna, Lehigh, Luzerne, Monroe, Northampton, Pike, Schuylkill, Susquehanna, Wayne, Wyoming
Southeast	**484-250-5900**	2 East Main Street Norristown, PA 19401 Phone: 484-250-5900	Bucks, Chester, Delaware, Montgomery, Philadelphia
Northcentral	**570-327-3636** **24 Hours**	208 West Third Street Suite 101 Williamsport, PA 17701	Bradford, Cameron, Centre, Clearfield, Clinton, Columbia, Lycoming, Montour, Northumberland, Potter, Snyder, Sullivan, Tioga, Union
Southcentral	**877-333-1904**	909 Elmerton Avenue Harrisburg, PA 17110 Phone: 717-705-4700	Adams, Bedford, Berks, Blair, Cumberland, Dauphin, Franklin, Fulton, Huntingdon, Juniata, Lancaster, Lebanon, Mifflin, Perry, York
Northwest	**814-332-6945** **After Hours:** **800-373-3398**	230 Chestnut Street Meadville, PA 16335 Phone: 814-332-6945	Butler, Clarion, Crawford, Elk, Erie, Forest, Jefferson, Lawrence, McKean, Mercer, Venango, Warren
Southwest	**412-442-4000** **24 Hours**	400 Waterfront Drive Pittsburgh, PA 15222 Phone: 412-442-4000	Allegheny, Armstrong, Beaver, Cambria, Fayette, Greene, Indiana, Somerset, Washington, Westmoreland

Unusual Reading Protocol

After you have been monitoring your stream site for about one year, you will start to know what measurements are typical in your stream. An "unusual reading" is a chemical measurement that seems higher or lower than normal. For example, the pH reading at your site for the past year ranged from 6.1 to 6.5pH units for 18 months. During your 19th month of sampling the reading is 4.0 pH units. This is an unusual reading of pH at your site.

If any of your chemical tests produce unusual readings:

1. Repeat the test.
2. Re-calibrate the Multi-parameter Meter.
3. Repeat the test again.

At least 2 of the 3 readings should produce similar readings. If at least 2 of your 3 readings are abnormal:

1. Bracket the extent of any potential abnormal conditions by taking readings at designated upstream and downstream locations.

   If you have not checked upstream and downstream locations for safety and accessibility, do NOT bracket the test site.

2. Interpret your abnormal readings by asking yourself the following questions:
   a. Was the unusual reading isolated to just the sample site?
   b. Were the upstream and/or downstream readings similar to the unusual reading at your site?
   c. Was there anything noticeably different at the site?

3. Report your results to your SEC's designated Web Host and inform them of your interpretation of the abnormal reading. The Web Host will email Nature Abounds at jim@natureabounds.org.

Chemical Waste Disposal

Environmentally Sound Monitoring

When you are using the chemical test kit to monitor water quality, you are using chemicals that are not already present in the water, and these chemicals must be handled properly to avoid causing pollution. Here are the steps to follow to be an "environmentally sound water quality monitor."

Reacted Sample Waste (what's in your test tubes when you finish!)

Two types of waste are generated during chemical analyses: nonhazardous and hazardous. These two types of waste must be separated for proper disposal. All wastes from the dissolved oxygen, total phosphate, total alkalinity, and the calibration standards from the pH and conductivity meters are classified as nonhazardous.

The nitrate test that uses the cadmium reduction method generates small amounts of cadmium, a heavy metal. The sulfate test generates small amounts of barium. The waste from these two chemical tests should be treated as hazardous due to the cadmium and barium in the solution.

Disposing of Nonhazardous Wastes. There are two options for disposal:

1. For disposal in a sink: Bring an empty plastic or glass container to your site and use it to collect all wastes from the dissolved oxygen, total phosphate, total alkalinity, and the calibration standards from the pH and conductivity meters. Take the container of waste and dispose in a sink. Be sure to run plenty of water while disposing and for a few minutes after dumping to dilute the chemicals and prevent corrosion of pipes.

2. For disposal in a trash receptacle: Collect the wastes in a container (an old coffee can works well) filled with an absorbent material like kitty litter. The kitty litter will absorb the water and bind the waste. This container should be tightly covered and may be placed in a trash receptacle as long as there is not free-flowing liquid remaining.

Disposing of Hazardous Wastes

Wastes from the nitrate and sulfate tests are classified as hazardous by the US EPA and should be collected separately in containers such as wide-mouthed plastic bottles that are clearly marked as "Toxic Waste-Nitrate Test-Cadmium" and "Toxic Waste-Sulfate Test-Barium." Remember to keep wastes from the nitrate and sulfate tests in separate containers! The wastes can be concentrated by evaporation (in a safe place, out of reach of children). The wastes should be kept in the marked container for proper disposal at a later date.

Care and Cleaning of Test Kits

General Cleaning

All labware (mixing bottles, syringes, sample tubes, etc.) should be washed after each use. Any residual contamination may alter test results. The cleaning method below applies to all test kits and supplies except the Total Phosphate Test Kit and the Nitrate Test Kit, both from the Old Hach Visual Kit (see Acid Wash Procedure below).

1. Clean with a nonabrasive detergent (phosphate-free) or a solvent such as isopropyl rubbing alcohol. Use a brush to clean all surfaces.
2. Rinse three times with cold tap water.
3. Rinse three times with distilled or deionized water.
4. Use a soft cloth (cheesecloth works well) for drying or allow to air dry. Never use papertowels or tissues as they may scratch.

Acid Wash Procedure

This method applies to cleaning labware for the Total Phosphate and Nitrate Test Kits. Always wear protective gloves and eyewear.

1. Wash each sample bottle or piece of glassware with a brush and phosphate-free detergent.
2. Rinse three times with cold tap water.
3. Rinse with 10 percent hydrochloric acid.
4. Rinse three times with deionized water.
5. Use a soft cloth (cheesecloth works well) for drying or allow to air dry. Never use paper towels or tissues as they may scratch.

Cleaning Supplies List

Detergent - phosphate-free and nonabrasive
Soft Cloths - cheesecloth works well
Cleaning Brushes - various shapes and sizes
10% Hydrochloric Acid
Red Acid Wash Safety Bottle
Deionized Water

Chapter 4:

Biosurvey

I. Biosurvey: Macroinvertebrate Collection Procedure (Page 1 of 5)

(Adapted from Volunteer Stream Monitoring: A Methods Manual, United States Environmental Protection Agency, Office of Water, Draft Document #EPA 841-B-97-003, November 1997 and from PA Senior Environmental Corps Volunteer Water Quality Monitoring Field Manual with some modifications. This protocol was revised by Kevin R. Kelly, PADEP, Citizens' Volunteer Monitoring Program and volunteer monitors, in March 2008)

The Biosurvey will be conducted between mid-October and mid-May. Sampling points should be positioned where improvements from the remediation are likely to occur. Sampling points can be identified by working with DEP biologists in both DEP's Central Office and Regional Offices or restoration project participants. The method you use to collect macroinvertebrates depends on the type of stream you are sampling - rocky bottom versus muddy bottom. Rocky bottom streams are defined as those with bottoms made up of gravel, cobbles, and boulders in any combination and usually have definite riffle areas. Because they are making their way downhill at some gradient, there are areas of fast-moving water. Muddy bottom streams have muddy, silty or sandy bottoms and lack riffles. Generally, these are slow moving, low-gradient streams but they can be deep, and mucky, and slippery. The goal is to sample the sort of habitats that tend to have the greatest abundance and diversity of benthic macroinvertebrate organisms. Places that are least impaired by pollution or alteration are the ones that most often contain a diverse population of pollution-sensitive macroinvertebrate organisms.

Wadeable Rocky Bottom Streams

Use the following method of macroinvertebrate sampling in wadeable streams that have riffles and gravel/cobble substrates. You will collect two or three samples at each site using the standardized approved kick net. You will need to note how many samples you collected – or more precisely, how much of the streambed was disturbed in order to get an adequate sample. You will combine the tally of organisms from a minimum of two samples in order to obtain a sample that is large enough to analyze.

1. Identify the Reach and Sampling Locations

The 30-meter reach and the sampling sites within the reach will be located in an accessible area of the stream where riffles are present. *Ideally, you will also do a Habitat Assessment in this same reach, so you will want to try to find a section of stream that is representative of the area and as long as 40 times the width, or a minimum of 30 meters. (Some Habitat parameters are better assessed by extending the assessment beyond 30 meters.).* If your access to the stream is near a bridge (or other significant unnatural feature such as a wall, storm drainpipe, tractor crossing, dam, etc.) it is usually best to work upstream of the bridge. The downstream end of your reach should be at least 15 meters upstream of any bridge or other human-made modification. Always avoid any significant dams that could impose a danger! If you must work downstream of a bridge due to access, moving at least 35 meters downstream of the bridge is a smart move. In any case, try to select your reach as far away from obstacles as practical, aiming to locate at a reasonable distance beyond the influences of the obstacles. Mark off your stream

reach. Choose three spots within the reach to use as potential sampling spots. The three spots should be in riffles because they are well-oxygenated and they are usually one of the places most utilized by the critters we're aiming to catch. If no riffles are present, you will have to use three "run" areas with cobble substrate types in order to maximize the likelihood of getting a representative and diverse sample.

2. Get Into Place

Always enter the stream and approach your sampling locations from the downstream end. This keeps you from biasing your second and third collections with dislodged sediment or macroinvertebrate organisms.

3. Sample the Downstream Site #1 First.

Select a 1 meter by 1 meter riffle area for sampling as site #1. Working in a team of two members, have one team member position the net at the downstream end of the sampling area. Selecting a mixed cobble area to sample is best and gravel beds and sand are worst and should be avoided! The "downstream team member" should have the net in front of him/her facing upstream and holding the kick net handles at a 45 degree angle to the water's surface. Be sure that the bottom of the net fits tightly against the stream bed so no macroinvertebrate organisms escape under the net. Use rocks from the sampling area to anchor the net against the stream bottom. Also, don't allow any water to flow over the top of the net back at your legs, or bugs will escape from there too.

4. Dislodge the Macroinvertebrate Organisms

A. The "upstream team member" should stand within the 1 meter by 1 meter area. Fill a bucket about 1/3 full with stream water. Pick up any large rocks (e.g., boulders >10 in.) within the area and look on the bottoms for any organisms, especially case-building caddisfly larvae. Hold them over the bucket and rub the rocks thoroughly with a soft-bristled brush (e.g., dishwashing or toilet brush) so any macroinvertebrate organisms clinging to the rocks will be dislodged into the bucket. The organisms can also be rubbed off the rocks into the stream so the organisms wash into the net. Then place the "cleaned" rocks outside of the sampling area. Continue "cleaning" the large rocks over the bucket until there are no large rocks within the sampling area. The large rocks should be returned to the sampling area once the sampling is completed.

B. Thoroughly disturb the substrate in the one-meter sampling area with your feet. Start at the upstream end of the sampling area (one meter upstream of the base of the net) and work your way toward the net. Stop when you reach the net and are certain that you have thoroughly stirred up the first two or three inches of the streambed in that one-meter sampling area. This should take about 3 minutes, but it is more important to do a consistently thorough job than to work according to the clock. As you dislodged organisms, they will be carried by the stream flow into the net. Before removing the net be sure to rub any large rocks that you used to anchor the net. Dislodge any organisms on those rocks into the bucket or the net.

5. Remove the Net

A. Try to remove the net without allowing any of the organisms it contains to wash away. While the downstream team member holds the top of the net handles, the kicker grabs the canvas strip at the bottom of the net and near the handles. Turn the canvas strip so it is at a sharp angle to the screening and it forms a blockage for any critter trying to exit from the bottom of the net. Then while holding the net in that position, grab the handles and lift your sample from the water. Removing the net from the stream with a slight forward scooping motion in the upstream direction also helps avoid losing any of your sample.

Spread the net out on the stream side and collect all the organisms right off the net. Once you have removed all collectible organisms, strain the contents of your bucket through the screen and again collect all the organisms. Repeat these sampling steps (if necessary) for the next sampling site. The primary disadvantages to working directly off the net are that the critters will eventually dry out and die, and they are hard to see on the typical tan color of most nets. Placing small amounts of the nets contents into a large shallow white pan partially filled with stream water will greatly aid anyone in doing a thorough job and it makes finding small moving organisms much easier. Doing this can not be over-emphasized. In any case, (even if you chose to initially pick directly from the net) always use the white pan with the contents of the net to double check it prior to returning the debris to the stream.).

[Alternative Procedure]: *Roll the kick net into a cylinder shape and place it vertically in the partially filled bucket. Pour or spray water down the net to flush its contents into the bucket. If necessary, pick the remaining debris and organisms from the net by hand. Release any fish, amphibians, or reptiles that were captured. Return the large rocks to the sampling area.*

B. If the bucket becomes too full with water, pour some out through the kick net screen. The screen will catch any organisms that are being carried by the water, and they should be returned to the bucket sample. You may use more than one bucket if you find that to be easier, or try using one with a screened bottom (600 μm mesh) to strain out excess water, if you have this equipment available.

6. Sorting Macroinvertebrate Organisms

Pour some of the contents of the bucket into a white dishpan (any large shallow white pan). Add some stream water if needed. Sort through a little debris at a time. Look for anything that swims, crawls, wriggles, or is hiding in a shell. Use tweezers, a spoon, pipette, or similar tool to remove all the organisms to the sorting trays (ice cube trays work great - put similar organisms in the same section). Estimate how many total organisms you caught in the first net. Proceed with the second net and third net (if needed).

IMPORTANT: Because life in the stream is naturally non-uniform in distribution, the biologist will almost always get a better representation of the stream's benthic

community by analyzing at least two kicks within a reach. You will need to develop a skilled judgment for your own stream as to whether more sampling will yield better results. Generally, if you have fewer than 300 organisms, or fewer than 5 Orders of organisms, or fewer than 4 different kinds of sensitive organisms (typically 4 different Families) in your combined first and second net samples you should sample at one additional site. The goal is always to work hard enough to get results that accurately reflect the stream's biological integrity. When any doubt exists, do an additional collection at the next spot within the reach, but there is no need to belabor the exercise where excellent stream-health is obvious.

On the other hand, if your first kick does not produce many organisms and you did not find any mayflies, another kick will not be necessary. This is indicating that the AMD impacted stream has not recovered biologically. Record the organisms in the first kick and don't belabor the process when it is obvious the organisms have not yet returned.

Here are some more things to look for in the first net to help determine if your stream is in very good health or whether additional sampling should be done:

- Life is abundant and not overwhelmingly dominated by just one or two tolerant or some-what tolerant kinds (Families)
- Ten or more kinds of organisms (Families) are in the collection
- Four or more sensitive kinds (Families) are in the collection
- The dominant (most abundant) Family is sensitive
- ***Collectively***, combining all the sensitive kinds (Families) the number would dominate the sample
- Mayflies, Stoneflies, and caddisflies (all 3) are present

7. Collect the Second Sample

Repeat steps 2 through 6 for the second sampling location and third sampling location if a third kick is needed. You may combine the samples from all sites into the same bucket because your analysis will be based on your total collection. This is called "compositing samples" and it will provide a better representation of the stream's macroinvertebrate community. You should have a minimum of 200 organisms, unless your stream has obvious problems, in which case obtaining this number of organisms might not be practical.

8. Identifying Macroinvertebrate Organisms

A. Use a hand lens or magnifying glass along with the aquatic macroinvertebrate identification sheets to identify your organisms. Use additional keys and field guides if available.
B. Record the number of individuals of each type of organism you have identified on your field data sheet.

Once you have identified all the organisms to the best of your ability, return them to the stream. Return the organisms near the area where you collected them. Most of them will successfully locate suitable habitat sites. Rinse the dishpan, bucket, and kick net making sure there are no organisms left clinging to them that might be transported to other sites.

9. Calculating the Stream Water Quality Rating

Assign one of the following abundance codes to each type of organism. Record the code next to the actual count on the field data sheet.
R (rare) = 1 to 9 organisms found in the sample.
C (common) = 10 to 99 organisms found in the sample.
D (dominant) = 100 or more organisms found in the sample.

The field data sheet divides the macroinvertebrate organisms into three groups based on their ability to tolerate pollution. The three tolerance groups are as follows:
Group I - Organisms that are sensitive to pollution and are typically found only in good-quality water and/or habitat.
Group II - Organisms that are somewhat sensitive to pollution and are typically found in good or fair-quality water and/or habitat.
Group III - Organisms that are tolerant of pollution and are typically found in all but the poorest-quality water and/or habitat.

Follow the instructions on the data sheet to calculate the various metrics and to determine a stream water quality rating.

It should be noted that the type of pollution the Stream Water Quality Rating sensitivity is based on is organic pollution and not pollution due to metals. Therefore, there are some EPT organisms that are not sensitive to metals that should only be found in good-quality water but will be found in AMD affected streams. Still, in most cases, EPT organisms will decrease or completely disappear in AMD affected streams. However, this rating will still give an indication of the macroinvertebrate community.

Wadeable Muddy Bottom Streams (Page 1 of 4)

Identify the 30-meter Reach and Sampling Locations in the same way as expressed above for Rocky Bottom Streams. That is, the reach containing the sampling spots will be 30-meters in length. (In order to properly evaluate certain habitat parameters when doing the Habitat Assessment you can extend this length.) Mark off your 30-meter stream reach. If possible, it should begin at least 15 meters upstream of any human-made modification (e.g., bridge, dam, drainpipe etc.).

Use the following method of macroinvertebrate sampling in wadeable streams that have muddy, silty or sandy bottoms or lack riffles (for example - slow-moving streams, coastal plain streams). You will combine samples from 20 "jabs" with a 1 foot wide D-frame net to get a representative sample of macroinvertebrate organisms.

1. Determine Types of Habitats Present

Muddy bottom streams usually have four habitat types - vegetated bank margins, snags and logs, aquatic vegetation beds and decaying organic matter, and silt/sand/gravel substrate. Not all streams will have all habitats present or present in significant amounts.

Habitat Descriptions:

Vegetated Bank Margin - This habitat consists of overhanging bank vegetation and submerged root mats attached to banks. The bank margins might also contain submerged, decomposing leaf packs trapped in root wads or lining the stream banks. This is ***generally a highly productive habitat*** and is often the most abundant type of habitat.

Snags and Logs - This habitat consists of submerged wood, primarily dead trees, logs, branches, roots, and leaf packs lodged between rocks or logs. This is also a ***very productive habitat***.

Aquatic Vegetation Beds and Decaying Organic Matter - This habitat consists of beds of submerged, green/leafy plants that are attached to the stream bottom. This habitat can be as productive as vegetated bank margins, and snags and logs, but is ***generally somewhat less productive***.

Silt/Sand/Gravel Substrate - This habitat includes sandy, silty or muddy stream bottoms, rocks along the stream bottom, and/or wetted gravel bars. This habitat might also contain algae-covered rocks. This is the ***least productive*** of the four muddy bottom stream habitats.

2. Determine How Many Jabs in Each Habitat

The goal is to collect a total of 20 jabs and combine the jabs into one combined sample. The D-frame net used to collect samples is 1 foot wide, and a jab should scrape along a length of approximately 1 foot of habitat. Twenty (20) jabs will equal sampling roughly 20 square feet of combined habitat. Sample the various habitats according to their prevalence and productive quality. If all four habitat types are all present and not very limited in area, this means you will be giving more jabs to the productive habitats and

fewer in the less productive habitat areas. If some habitats are plentiful and others are sparse in frequency and area covered, always aim to sample the most productive habitat to the extent possible while always ***also*** sampling all the habitats present, to the extent possible, even if you can only take one or two jabs in the least desirable or least frequently occurring type.

No matter what the make-up of your stream's habitats, note on your data sheet the types of habitats present and the number of jabs taken from each habitat. This data will help characterize your findings.

The following are some scenarios to help you determine how many jabs to take in each habitat.

Scenario 1: If all four habitats are present in plentiful amounts, jab the vegetated banks 10 times and divide 10 jabs among the remaining three habitats.

Scenario 2: If three habitats are present in plentiful amounts and one is absent, jab the silt/sand/gravel substrate - the least productive habitat - 5 times and divide the remaining 15 jabs among the other two more productive habitats.

Scenario 3: If only two habitats are present in plentiful amounts, the silt/sand/gravel substrate will most likely be one of those habitats. Jab it 5 times and the more productive habitat 15 times.

Scenario 4: If some habitats are plentiful and others are sparse in frequency and area covered, sample the sparse habitats to the extent possible (especially if they are the more productive types), even if you can only take one or two jabs. Take the remaining jabs from the plentiful habitat(s). This rule also applies if you cannot reach a habitat because of unsafe stream conditions. Jab a total of 20 times.

3. Get Into Place

This type of sampling requires only one person to disturb the stream habitats. Sampling partners can stand outside of the sampling area holding the bucket and dish pan to assist in rinsing the net contents into the bucket after every few jabs.

Fill the bucket and dish pan with clear stream water. Use the dish pan and assist in rinsing the net contents into the bucket.

Check the net to be sure it is clean from the last use. Enter the stream outside and downstream of your first sampling location.

4. Dislodge the Macroinvertebrate organisms

Approach the first sample site from downstream and sample as you walk upstream. Here is how to sample in four habitat types:

Vegetated Bank Margins - Jab the vegetated bank margins vigorously, with an upward motion, brushing the net against vegetation and roots along the bank. The entire jab motion should occur underwater.

Snags and Logs - Hold the net with one hand under the section of submerged wood you are sampling. With the other hand (which should be gloved), rub about 1 square foot of area on the snag or log. Scoop organisms, bark, twigs, or other organic matter you dislodge into your net. Each combination of log rubbing and net scooping equals one jab.

Aquatic Vegetation Beds - Jab vigorously, with an upward motion, against or through the plant bed. The entire jab motion should occur underwater.

Silt/sand/gravel Substrate - Place the net with one edge against the stream bottom and push it forward about a foot (in an upstream direction) to dislodge the first few inches of silt, sand, gravel or rocks. To avoid gathering a net full of mud, periodically sweep the net back and forth in the water, making sure that water does not run over the top of the net. This will allow fine silt to rinse out through the net.

When you have completed each jab (up to 20 jabs) dump the contents of the net in the bucket and rinse the reversed net thoroughly into the bucket to catch remaining bugs. If necessary, pick any clinging organisms from the net by hand and put them in the bucket.

5. Sorting Macroinvertebrate organisms

Pour the contents of the bucket into a white dishpan (or other large shallow white pan). Add more stream water if needed. Sort through the debris looking for anything that swims, crawls, wriggles, moves or is hiding in a shell. Use tweezers, spoons or turkey baster to remove the insects to the sorting trays (ice cube trays work great - put like organisms in the same section).

6. Identifying Macroinvertebrate organisms

Use a hand lens or magnifying glass along with the aquatic macroinvertebrate identification sheets to identify your organisms.

Record the number of individuals of each type of organism you have identified on your field data sheet.

Once you have identified all the organisms to the best of your ability, return the macroinvertebrate organisms to the stream. Return the organisms to the downstream section of the stream (near site #1) to allow them to locate suitable attachment sites. Rinse the dishpan, bucket, and D-frame net making sure there are no organisms clinging to the sides.

7. Calculating the Stream Water Quality Rating

Assign one of the following abundance codes to each type of organism. Record the code next to the actual count on the field data sheet.

R (rare) = 1 to 9 organisms found in the sample

C (common) = 10 to 99 organisms found in the sample

D (dominant) = 100 or more organisms found in the sample.

The field data sheet divides the macroinvertebrate organisms into three groups based on their ability to tolerate pollution. The three tolerance groups are as follows:

Group I - Organisms that are sensitive to pollution and are typically found in good-quality water.

Group II - Organisms that are somewhat sensitive to pollution and are typically found in fair-quality water.

Group III - Organisms that are tolerant of pollution and are typically found in poor-quality water.

Follow the instructions on the data sheet to calculate the stream water quality rating.

Benthic Macroinvertebrate Survey Equipment Checklist

For Semi-annual Monitoring - use with Water Quality Monitoring Equipment Checklist

- □ All Equipment on Water Quality Monitoring Checklist
- □ Kick Net
- □ White dishpan or other shallow white tray
- □ Containers for sorting (i.e. ice cube trays)
- □ Tweezers, soft paint brush, and/or turkey baster
- □ Magnifying lens or box
- □ Fishing License
- □ Soft bristle brush (to scrub macroinvertebrates off rocks)
- □ BioSurvey Field Data Sheets and ID sheets (See Appendix).

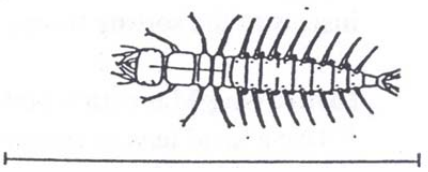
Biosurvey: Identification Chart *(p 1 of 6)*

Bar lines next to each organism ├──────┤ *indicate relative size.*

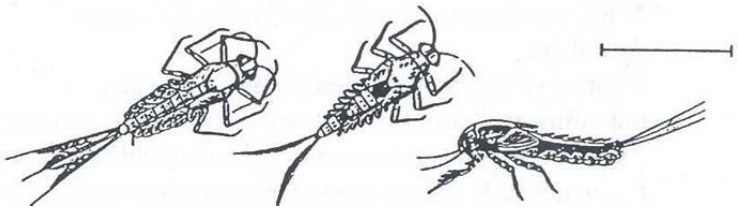
Group I – sensitive

Water Penny Larvae - Order Coleoptera:
4-6 mm flattened disclike forms, found clinging to rocks a dorsal plate conceals the head and 6 legs.

Dobsonfly Larva (Hellgrammite) - Order Megaloptera: 25-90 mm, dark colored, 6 legs, well developed chewing mouthparts, 2 short antennae, 8 abdominal segments each with a pair of filaments; 2 anal prolegs with hooks; has gill tufts at base of legs.

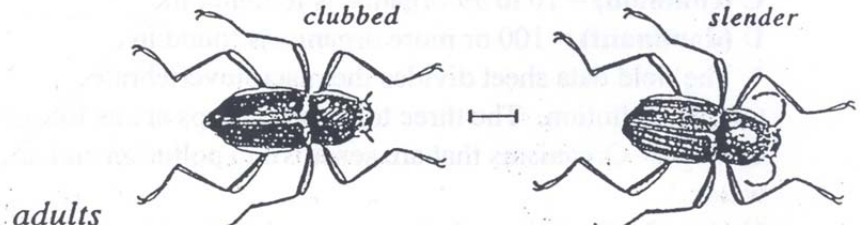


Mayfly Nymph - Order Ephemeroptera:
3-20 mm (not including tails), elongate, cylindrical to flattened form, head with slender antennae, 6 legs with one claw or no claw, wing pads present, platelike or feathery gills along abdomen, 3 long tails (sometimes 2).

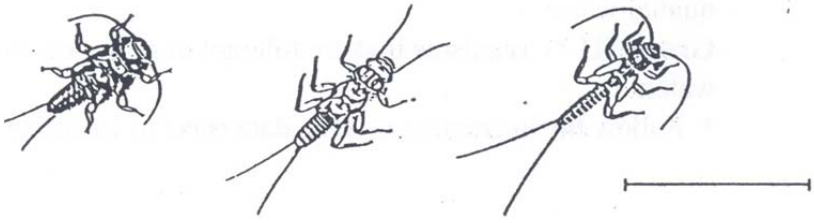


Gilled Snail - Class Gastropoda:
vary in size; a thin, horny plat, the operculum, seals the opening to the shell when the foot is retracted.

Riffle Beetle - Order Coleoptera: 1-8 mm, oval elongate body, 6 legs, crawl underwater; antennae usually slender but are sometime clubbed.



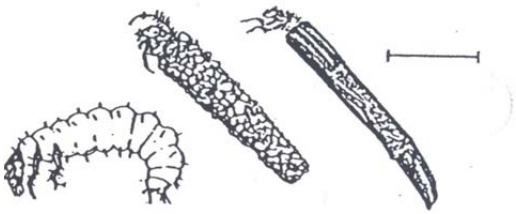
Stonefly Nymph - Order Plecoptera:
5-35 mm (not including tails), 6 legs with clawed tips, long slender antennae, 2 tails,gills may be present on mouthparts, thorax, and/or legs, gills, rarely present on abdomen,hardened thoracic segments.



Biosurvey: Identification Chart *(p 2 of 6)*

Group I – sensitive *(continued)*

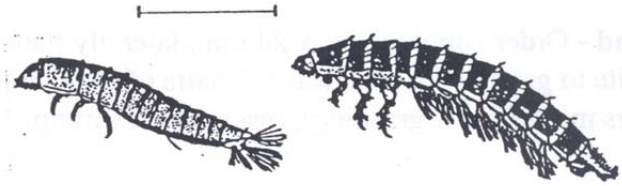
Non-Net Spinning (Case building) Caddisfly Larva – Order Trichoptera: 2-40 mm, usually found within a case attached to the bottom of rocks, case made of plant material or rock particles, long and caterpillar-like, distinct head, chewing mouthparts, antennae reduced or inconspicuous, 3 pairs of legs, no wing pads or tails, end of abdomen has prolegs each with a claw.



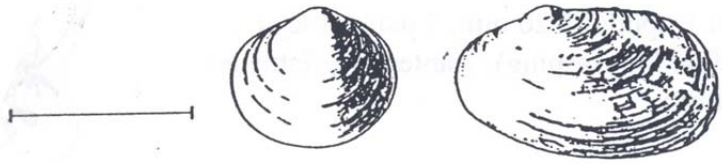
Biosurvey: Identification Chart *(p 3 of 6)*

Group II - somewhat sensitive

Beetle Larvae - Order Coleoptera: 2-60 mm, distinct head, 2 antennae, 6 legs, 8 to 10 segmented abdomen, may or may not have abdominal gills orlateral filaments.

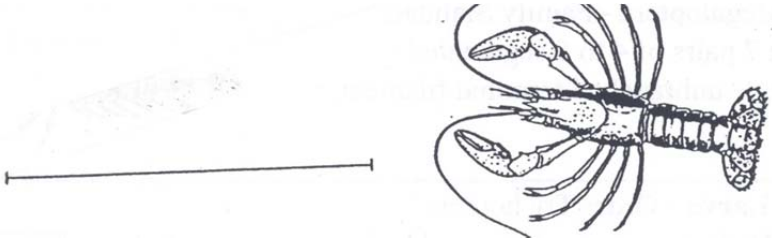


Clams - Class Pelecypoda: 2-250 mm, two-piece (bivalve) shell, commonly oval with concentric growth lines.

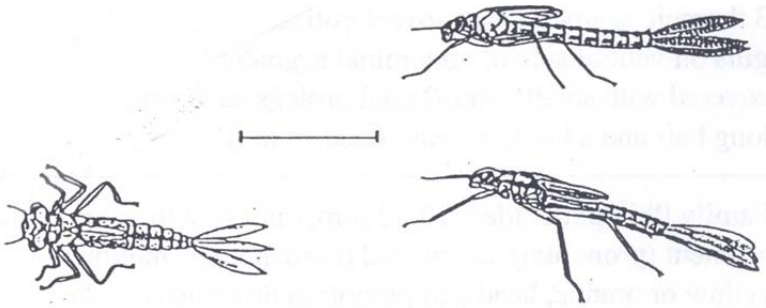


Cranefly Larva - Order Diptera - Family Tipulidae: 10 - 100 mm (sometimes larger), white, green or brown caterpillar-like body, segmented, abdomen may be bulbous or end in fleshy projections.

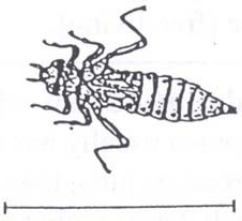
Crayfish - Order Decapoda: 10-150 mm, 2 large claws, 8 legs, 2 long antennae, resembles a tiny lobster.



Damselfly Nymph - Order Odonata -Suborder Zygoptera: 10-30 mm, elongate and slender forms, 2 antennae, 6 legs, 2 pairs of wing pads, no gills along body, 3 leaflike "tails" (actually the gills) on end of abdomen; distinctive lower lip is large and extendable.



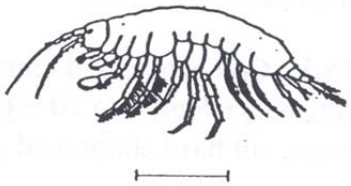
Dragonfly Nymph - Order Odonata - Suborder Anisoptera: 12-15 mm, large eyes, wide oval to round abdomen, 6 hooked legs, gills in rectum.



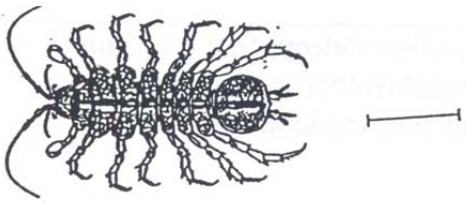
Biosurvey: Identification Chart *(p 4 of 6)*

Group II - somewhat sensitive *(continued)*

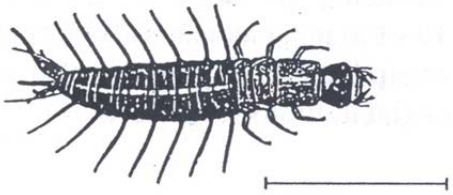
Scud - Order Amphipoda: 5-20 mm, laterally flattened, white to grey, swims sideways, 7 pairs of legs (first two pairs modified for grasping), resembles a shrimp.



Sowbug - Order Isopoda: 5-20 mm, 7 pairs of legs (first pair modified for grasping), 2 antennae, flattened body, top to bottom.

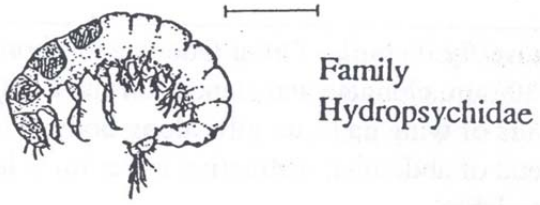


Fishfly Larva - Order Megaloptera - Family Corydalidae: 10-25 mm, reddish-tan often with yellowish streaks, no gill tufts underneath abdomen, resembles a small hellgrammite; have 2 breathing tubes on last abdominal segment; 2 anal prolegs with hooks.

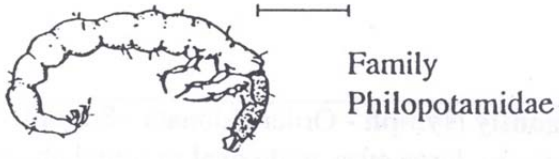


Alderfly Larva - Order Megaloptera - Family Sialidae: 10-25 mm, abdomen with 7 pairs of 4 to 5 segmented lateral filaments and a single unbranched terminal filament.

Net-Spinning Caddisfly Larva - Order Trichoptera
Family Hydropsychidae: 10-16 mm, strongly curved body, 3 thoracic segments that are sclerotized (hardened), branched gills on ventral side of abdominal segments, (abdomen covered with small hairs), 2 anal prolegs each with tuft of long hair and a hook, no case (free-living).



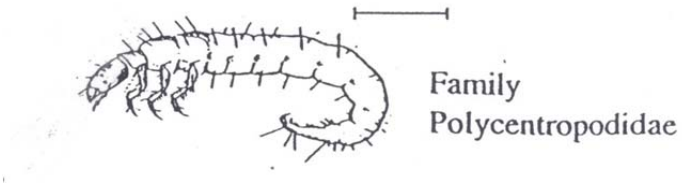
Family Philopotamidae: 10-12 mm, only first thoracic segment (pronotum) sclerotized (hardened), sometimes yellow or orange, head and pronotum brownish orange, pronotum bounded posteriorly by pronounced black line, 3 pairs of legs, no anal prolegs or abdominal gills, abdomen strongly curved, no case (free-living).



Biosurvey: Identification Chart *(p 5 of 6)*

Group II - somewhat sensitive *(continued)*

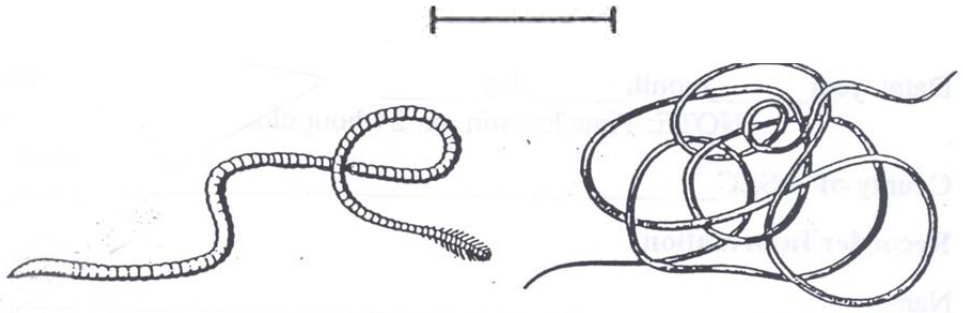
Family Polycentropodidae: 10-25 mm, whitish color tinged with purple, abdomen usually has a lateral fringe of short hairs but never possesses gills, lower end of abdomen strongly curved; 2 anal prolegs.



Biosurvey: Identification Chart *(p 6 of 6)*

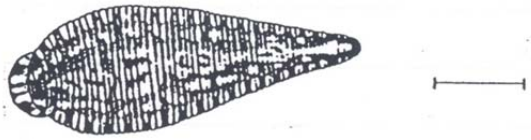
Group III - Tolerant

Aquatic Worm – Class Oligochaeta: 1-30 mm (sometimes over 100 mm), elongate, cylindrical worms, segmented body (may be difficult to see segments), color variable.

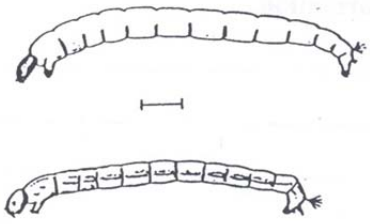


Blackfly Larva - Order Diptera - Family Simulidae: 3-12 mm, cylindrical body with one end wider, black head with fanlike mouth brushes.

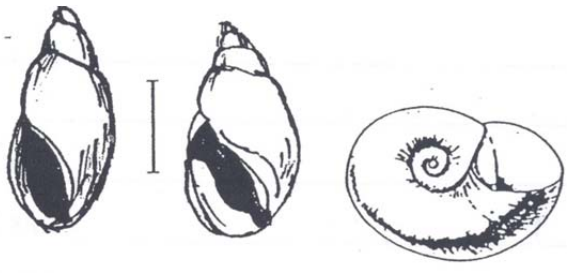
Leech - Order Hirudinea: 5-100 mm, flattened segmented body, both anterior and posterior suckers.



Midge Fly Larva - Order Diptera - Family Chironomidae: 2-20 mm, slender and cylindrical curved body, dark head with 2 prolegs on each side of the bottom of the first segment behind the head.



Other Snails - Class Gastropoda: non-gill breathing snails, do not have an operculum to close the shell opening.



Stream Habitat Assessment Procedure

(Adapted from Volunteer Stream Monitoring: A Methods Manual, United States Environmental Protection Agency, Office of Water, Draft Document #EPA 841-B-97-003, November 1997.)

Each time you conduct macroinvertebrate sampling you will also assess the stream habitat for fish, macroinvertebrates, and plants. Just as with macroinvertebrate sampling the type of stream habitat - rocky bottom versus muddy bottom - affects your assessment procedures.

Rocky Bottom Habitats

Conduct the habitat assessment twice a year, in the spring and in the fall, at the site that you used for your macroinvertebrate sampling.

1. **Attachment sites for macroinvertebrates** are essentially the amount of living space or hard substrates (rocks, snags, etc.) available for aquatic insects and snails. Many insects begin their life underwater in streams and need to attach themselves to rocks, logs, branches, or other sub-merged substrates. In streams unimpaired by pollution, the greater the variety and number of available living spaces or attachment sites, the greater the variety of insects the stream habitat could support. Optimally, cobble should predominate and boulders and gravel should be common. The availability of suitable living spaces for macroinvertebrates decreases as cobble becomes less abundant and boulders, gravel, or bedrock become more prevalent.

2. **Embeddedness** refers to the extent that rocks (gravel, cobble, and boulders) are surrounded by, covered, or sunken into the silt, sand, or mud of the stream bottom. As rocks become embedded, fewer living spaces are available to macroinvertebrates and fish for shelter, spawning and egg incubation. To estimate the percent of embeddedness, observe the amount of silt or finer sediments overlying and surrounding the rocks. If kicking does not dislodge the rocks or cobbles, they might be greatly embedded.

3. **Shelter for fish** and macroinvertebrates includes the relative quantity and variety of natural structures in the stream, such as fallen trees, logs, and branches; root wads; large cobble and boulders; and undercut banks that are available to fish for hiding, sleeping, or feeding. A wide variety of submerged structures means more living spaces in a stream and the more types of fish and other aquatic life the stream can support. ***Assess the stream as far as you can see.***

4. **Channel alteration** is a measure of large-scale changes in the shape of the stream channel. Many streams in urban and agricultural areas have been straightened, deepened, dredged, or diverted into concrete channels, often for flood control purposes. Such streams have far fewer natural habitats for fish, macroinvertebrates, and plants than do naturally meandering streams. Channel alteration is present when the stream runs through a concrete channel; when artificial embankments, riprap, and other forms of artificial bank stabilization or structures are present; when the stream is very straight for

significant distances; when dams, bridges, and flow-altering structures such as stormwater pipes are present; when the stream is of uniform depth due to dredging; and when other such changes have occurred. Signs that indicate the occurrence of dredging include straightened, deepened, and otherwise uniform stream channels, as well as the removal of streamside vegetation to provide dredging equipment access to the stream. ***Assess channel alteration up and down the stream as far as you can see.***

5. **Sediment deposition** is a measure of the amount of sediment that has been deposited in the stream channel and the changes to the stream bottom that have occurred as a result of the deposition. High levels of sediment deposition create an unstable and continually changing environment that is unsuitable for many aquatic organisms. Sediments are naturally deposited in areas where the stream flow is reduced, such as pools and bends, or where flow is obstructed. These deposits can lead to the formation of islands, shoals, or point bars (sediments that build up in the stream, usually at the beginning of a meander) or can result in the complete filling of pools. To determine whether sediment deposits are new, look for vegetation growing on them: new sediments will not yet have been colonized by vegetation.

6. **Stream velocity and depth combinations** are important to the maintenance of healthy aquatic communities. Fast water increases the amount of dissolved oxygen in the water, keeps pools from being filled with sediment, and helps food items like leaves, twigs, and algae move more quickly through the aquatic system. Slow water provides spawning areas for fish and shelters macroinvertebrates that might be washed downstream in high stream velocities. Similarly, shallow water tends to be more easily aerated (i.e. holds more oxygen), but deeper water stays cooler longer. Thus the best stream habitat includes all of the following velocity/depth combinations and can maintain a wide variety of organisms.

* slow (<1 ft/sec or <0.3048 m/sec), shallow (0.4572 m or <1.5 ft)
* slow, deep
* fast, deep
* fast, shallow

7. **Channel flow status** is the percentage of the existing channel that is filled with water. The flow status changes as the channel enlarges or as flow decreases as a result of dams and other obstructions, diversions for irrigation, or drought. When water does not cover much of the streambed, the living area for aquatic organisms is limited.

For the next three parameters, evaluate the condition of the right and left stream banks separately. Define the "left" and "right" banks by standing at the downstream end of your study stretch and looking upstream. Each bank is evaluated on a scale of 0-10.

8. **Bank vegetative protection** measures the amount of the stream bank that is covered by vegetation. The root systems of plants growing on stream banks help hold soil in place, reducing erosion. Vegetation on banks provides shade for fish and macroinvertebrates and serves as a food source by dropping leaves and other organic matter into the stream. Ideally, a variety of vegetation should be present, including trees, shrubs, and grasses. Vegetative disruption can occur when the grasses and plants on the stream banks are mowed or grazed, or when the trees and shrubs are cut back or cleared.

9. **Condition of banks** measures erosion potential and whether the stream banks are eroded. Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks and are therefore considered to have a high erosion potential. Signs of erosion include crumbling, unvegetated banks, exposed tree roots, and exposed soils.

10. **The riparian vegetative zone** width is defined as the width of vegetation from the edge of the stream bank. The riparian vegetative zone is a buffer to prevent pollutants from entering a stream. It also controls erosion and provides stream habitat and nutrient input to the stream. A wide, relatively undisturbed riparian vegetative zone helps maintain a healthy stream system; narrow, far less useful riparian zones occur when roads, parking lots, fields, lawns, and other cultivated areas, bare soil, rocks or buildings are near the stream bank. The presence of "old fields" (i.e. previously developed agricultural fields allowed to revert to natural conditions) should be rated higher than fields in continuous or periodic use. In arid areas, the riparian vegetative zone can be measured by observing the width of the area dominated by riparian or water-loving plants, such as willows, marsh grasses, and cotton wood trees.

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Muddy Bottom Habitats

Conduct the habitat assessment twice a year, in the spring and in the fall, at the site you used for your macroinvertebrate sampling.

1. **Shelter for fish and attachment sites for macroinvertebrates** are the amount of living space and shelter (rocks, snags, and undercut banks) available for fish, insects, and snails. Many insects attach themselves to rocks, logs, branches, or other submerged substrates. Fish can hide or feed in these areas. The greater the variety and number of available shelter sites or attachment sites, the greater the variety of fish and insects in the stream. Many of the attachment sites result from debris falling into the stream from the surrounding vegetation. When debris first falls into the water, it is termed "new fall" and it has not yet been "broken down" or conditioned by microbes for macroinvertebrate colonization. Leaf material or debris that is conditioned is called "old fall." Leaves that have been in the stream for some time turn brown or dull yellow, becomes blackened or dark in color; smooth bark become coarse and partially disintegrated, creating holes and crevices. It might also be slimy to the touch.

2. **Pool substrate characterization** evaluates the type and condition of bottom substrates found in pools. Pools with firmer sediment types (e.g. gravel, sand) and rooted aquatic plants support a wider variety of organisms than do pools with substrates dominated by mud or bedrock and no plants. In addition, a pool with one uniform substrate type will support far fewer types of organisms than will a pool with a wide variety of substrate types.

3. **Pool variability** rates the overall mixture of pool types found in the stream according to size and depth. The four basic types of pools are large-shallow, large-deep, small-shallow, and small-deep. A stream with many pool types will support a wide variety of aquatic species. Rivers with low sinuosity (few bends) and monotonous pool characteristics do not have sufficient quantities and types of habitats to support a diverse aquatic community.

4. **Channel alteration** (see description in habitat assessment for rocky bottom streams.)

5. **Sediment deposition** (see description in habitat assessment for rocky bottom streams.)

6. **Channel sinuosity** evaluates the sinuosity or meandering of the stream. Streams that meander provide a variety of habitats (such as pools and runs) and stream velocities that

reduce the energy from current surges during storm events. Straight stream segments are characterized by even stream depth and unvarying velocity, and they are prone to flooding. To evaluate this parameter, imagine how much longer the stream would be if it were straightened out.

7. **Channel flow status** (see description in habitat assessment for rocky bottom streams)

8. **Bank vegetative protection** (see description in habitat assessment for rocky bottom streams)

9. **Condition of banks** (see description in habitat assessment for rocky bottom streams)

10. **The riparian vegetative zone width** (see description in habitat assessment for rocky bottom streams)